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EXECUTIVE SUMMARY

LEAKAGE RATE FROM LOCA-AGED INFLATABLE AIRLOCK SEALS PICKERING NGS 'B' PERSONNEL DOORS

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In order to demonstrate to the Atomic Energy Control Board that an air-lock inflatable seal will function after a LOCA exposure, an inflatable seal intended for personnel doors at the Pickering NGS 'B' was exposed to the thermal/moisture conditions of the LOCA requirement. While attempting to determine the post-LOCA leakage rate it was found that additional leaks developed during each post-LOCA inflation/deflation cycle. The seal had been significantly and irreparably deteriorated by the LOCA exposure. The test has demonstrated that this type of LOCA exposed seal should not be expected to withstand either additional pressure above 207 kPa or additional inflation/deflation cycling. A higher inflation pressure and/or cycling will reduce the likelihood of a post-LOCA seal retaining an inflation pressure sufficient to prevent leakage across the seal.

GW F
SLC

job	file	date	report no.
740632-171-450	835.6132	January 4, 1985	84-282-K

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To Mr. J.P. Oreskovich
Manager of Engineering
Pickering NGS 'B'

LEAKAGE RATE FROM LOCA-AGED INFLATABLE AIRLOCK SEALS PICKERING NGS 'B' PERSONNEL DOORS

G.W. Fayle/D.C. Cordingley

An inflatable seal subjected to the thermal conditions of the LOCA exposure was found to have been significantly and irreparably deteriorated by the exposure test. Although the initial leakage rate of 1.4 L/min at 207 kPa was moderate, it is unlikely that the seal will be able to withstand either additional pressure above 207 kPa or additional inflation/deflation cycling without failure to retain an inflation sealing pressure sufficient to prevent leakage across the seal.

An inflatable airlock seal, model 8142-2, intended for personnel doors at Pickering NGS 'B', was subjected to a LOCA simulation exposure by Westinghouse Canada Ltd according to the procedure "Environmental Testing of Airlock Pneumatic and Electrical Components for Pickering NGS 'B'"/1/. This test did not include any exposure to γ-radiation. The seal was then submitted to the Chemical Research Department to measure the leakage rate, to locate and repair (or clamp off) the leaks and remeasure leakage rate, to determine the magnitude of any additional leaks, and to determine if possible the cause of the leaks/2/. This report summarizes the findings of the investigation.

Pressure Test

The unconfined seal was inflated and maintained at each of the following test pressures: 207, 193, 179, 165, 152 and 138 kPa. The air flows required to maintain these pressures were determined. The results are presented graphically in Figure 1.

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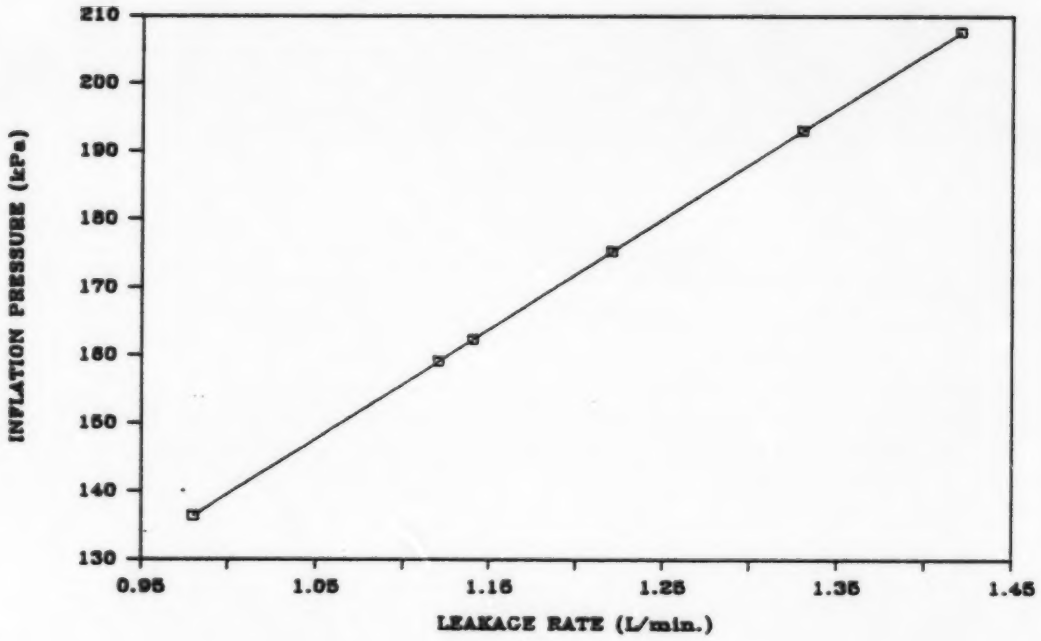
Figure 1

Relationship Between Inflation Pressure
and Leakage Rate of LOCA Aged Inflatable Seal



This leakage was initially presumed to be the leakage rate for the leakage sites which caused Westinghouse Canada Ltd. to report that the internal pressure fell from 201 kPa to 57 kPa within one hour. This is well below the 275 kPa initial and 240 kPa retention specified after 1 hour/3/. The seal was deflated then pressurized slightly to raise the striker face. The leakage sites were located by checking for bubbles while the seal was immersed under a few inches of water. Three leak sites were located at one of the two factory splices in the wall of the seal but not in the striker face.

Repairs and Retest

In order to determine if the seal would develop additional leak sites, the leak sites were repaired as follows: (a) the seal was air dried (b) the leak sites were cleaned with trichloro-ethane (c) an RTV silicone adhesive was applied immediately over the leak sites and allowed to cure overnight. The seal was then pressurized to repeat the leakage test. At 138 kPa (and an

indicated flow of 0.25 L/min) additional leakage was heard. The pressure was released and the leaks were located and repaired as before. When the seal was pressurized two new leaks were found, again, at the splice. These were repaired as before. The seal was inflated for its third pressure/leakage test. At 138 kPa (and an indicated flow of 0 L/min) there was a sudden movement of the ball in the rotameter indicating the instantaneous formation of a new leak. The seal was pressurized to 207 kPa and the leakage measured. The seal was then deflated, pressurized slightly as before and inspected to determine if either the repair site had failed or additional new leaks had resulted from the pressurization/depressurization cycles resulting from the testing. Air bubbles showed the following: (a) the repaired sections were not leaking; (b) two new leaks were found in the opposing wall of the splice just repaired; (c) one new leak was found in the side wall outside the splice areas; and (d) two vertical slits in the wall of one of the two splices which, until now, had not caused bubbling, were now leaking. It is therefore evident that the inflatable seal had been sufficiently deteriorated by the LOCA simulation exposure that it is failing at new locations with each subsequent inflation/deflation cycle. For in-service seals a higher inflation pressure and/or cycling will reduce the likelihood of the seal retaining an inflation pressure sufficient to prevent leakage across the seal.

At your request we have refrained from dissection of the seal until these findings have been tabled, reviewed, and the need for further pressure or cycling tests assessed.

Conclusions

1. The inflatable seal after the LOCA simulation exposure is deteriorated to a point such that each subsequent inflation/deflation causes new leaks to develop.

2. Although it had been anticipated that the leaks would be located in the striker face, the traditional leak site, this was not the case with this seal. Eight of the nine leaks found were at the splices and were in the body of the seal and not at the striker face.

3. As additional leaks developed on each post LOCA inflation/ deflation cycle, it is unlikely that the seal will be able to withstand either additional pressure above 207 kPa or additional inflation/deflation cycling without failure to retain sufficient inflation pressure to prevent leakage across the seal.

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1. Attachment to Requisition RH2113005 to Canadian Westinghouse 1983.02.16 "Environmental Testing of Airlock Pneumatic and Electrical Components for Pickering NGS 'B'".

2. Sheridan, V.A., "Pickering NGS 'B' Leakage Testing of LOCA Test Airlock Seal", Memorandum to D.C. Cordingley, October 21, 1983, File NK30-21130P.

3. Ontario Hydro Specification L-625SM-82, "Inflatable Seals for Doors of Containment and Confinement Areas, Nuclear Generating Station".

4. Sheridan, V.A., "Pickering GS 'B' Review of Ontario Hydro Research Report 84-282-K Leakage Rate from LOCA-Aged Inflatable Airlock Seals Pickering NGS 'B', Personnel Doors", Memorandum to R.W. Glass, Supervising Chemist, Research Division, November 22, 1984, File NK30-21130P.